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DIRECTIONS

FOR THE

PREPARATION AND MANAGEMENT

OF THE

MARINE AQUARIUM.

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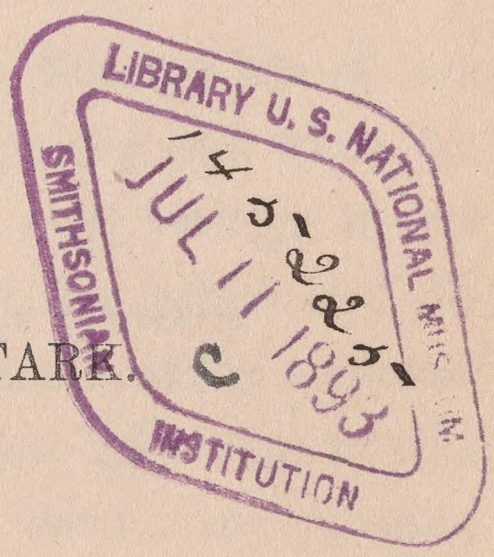
THE

MARINE AQUARIUM

DIRECTIONS FOR ITS PREPARATION AND MANAGEMENT.

BY R. M. STARK.



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DIRECTIONS

FOR THE

PREPARATION AND MANAGEMENT OF THE MARINE AQUARIUM.

THE study of Marine Zoology has of late attracted much attention, and when we consider the beauty and variety of the objects it brings under our notice, and the curious structure and habits of the animated beings of which it treats, we cannot be surprised that it should have many votaries. Marine Botany has also a similar claim with her sister science.

The sea is, at all times and in all climates, an object of interest to the student of natural science, as well as the general observer. Many valuable works have been written treating of its physical condition, and the history of its inhabitants, from the microscopic animalcule to the gigantic whale.

On some branches of the natural history of marine animals, however, we have yet much to learn—and on none more than the habits and instincts of the smaller or Invertebrate families.

Here we have an interesting subject for amusement and research, and the prosecution of it has been much facilitated by the adoption or invention of the Aquarium.

This, as is well known, is an imitation of the sea-side pools found on all rocky shores—themselves seas in miniature—in which the weeds and corals clothe the bottom and sides, affording air, food, and protection to the animated inhabitants which make it their home.

The labours and experiments of Messrs. Warrington, Gosse, and others, have contributed much to promote this interesting pursuit, and we must refer those who wish to avail themselves fully of the benefit derived from the researches of these gentlemen, to several interesting works published by the latter. The object of the present "directions" is to guide those who are just commencing to devote attention to the Aquarium, giving, as briefly as possible, the fullest and most recent experience of those who have made the Aquarium and its management their study.

Though simple in contrivance, and sound in the principles on which it is established, it is at first rather difficult for the inexperienced to get it into order. When repeated failures take place, the amateur gets disheartened, and may be tempted to give up in despair of success. It is hoped that, by attending to the several rules laid down here, in as popular language as possible, sufficient information will be found for commencing and carrying out the enterprise.

Let us notice, first, the Aquarium itself:—

Plan and Materials for its Construction.—Any vessel of earthenware or glass, thoroughly watertight, will be found suitable for an Aquarium, though some forms and sizes are more eligible than others, which will be better understood when we come to speak of the animals and plants of which it is to be made the receptacle. Where many of these are required by large experimenters for keeping apart sickly individuals, or scientific purposes alone, jelly jars, small pie-dishes, and similar vessels, will be sufficient. Glass, however, is evidently the most beautiful material for the Aquarium, and can be had in great variety of quality and form to suit different tastes. The glass receptacles are either vessels in the shape of circular vases of one piece, or tanks with rectan-

gular sides fixed together at the corners by pillars of wood or metal, and placed upright by means of grooves in a bottom of slate, or some similar smooth and flat material. These latter being more complicated in their construction, and requiring, when of any size, to have their sides formed of plate-glass, are necessarily much more expensive than the vase. As they admit of being made of much greater dimensions, they should always be used by those who wish considerable variety in the contents of the Aquarium, while those, whose views on this subject are more modest, may be content with a moderate-sized vase. The vase chiefly approved is that of a bell or bee-glass inverted, with the knob fixed in a turned base or pedestal of wood, according to the taste of the owner.* This must be done with some nicety, that the vase be secured against any danger of capsizing, and, at the same time, admit of being turned round on the solid base, that the contents may be viewed on all sides. Fern-dishes with flat bottoms are also favourites with many. The circular form of the glass has necessarily the effect of magnifying and distorting to the view the contents of the Aquarium, which gives it a more imposing appearance to the

* An illustration of an Aquarium of this description is given on the cover.

general observer, while the straight sides of the tank afford a better opportunity for seeing the contents of a natural size, or examining them with the aid of the magnifying glass. These tanks are sometimes made with sides of slate similar to what is used for the bottom, as enough of light is obtained from the back and front walls. To admit of the rays of light falling directly on the contents, and imitate, in some measure, a sloping shore, it has been recommended to slope the bottom from the side next the window towards the interior. The external ornament which may be given to these tanks, besides the stands on which they may be placed, and their combination with fern-cases and other objects, cannot be discussed in the space we propose to occupy, but afford much scope for exercising the ingenuity and taste of lady Aquarians.

Shallow milk-pans and dishes of similar shape suit admirably for zoophytes and many other minute animals which require the aid of the microscope in their examination, as, from the large exposure of surface to the air, delicate members of these families remain longer in healthy state than in vessels of a different construction.

Having selected the vase or tank which is found best to suit the means and taste of the Aquarian, the

next step is to provide and place in it the various materials best adapted for maintaining, in a healthy state, the various productions with which it is proposed to stock it.

Bottom or Floor.—To imitate the sea-shore, or the bottom of the pools which the animals inhabit in a state of nature, it is necessary to have some sand, gravel, or pebbles in the Aquarium. Each material has been advocated by different individuals, according as they found them useful for the animals they had in confinement. Fine river or sea-side sand, after being thoroughly washed from all impurities, may be spread equally over the bottom of the Aquarium to the depth of about two inches. Shell gravel may be used in the same way, and over either of them may be placed a layer of pebbles or fragments of rock, foreign coral, etc., as the taste of the owner may approve. The sand is absolutely necessary, where certain animals have a propensity to burrow, and there are a good many of that kind. The great danger in such a bottom is the death of one or more animals in the sand, which may frequently occur, and, if undetected, will speedily pollute the water and injure their neighbours. Where pebbles or rocks alone are used, this evil can be more readily guarded against.

Besides this floor of one or other of these materials, it is desirable to have some larger and more upright stones, rocks, or corals, with a view, at once of giving a variety to the interior, and affording a site to the plants and animals, and the means of shading to those that court it. Rocks or stones of various descriptions will suit for this purpose. Stalactite of lime, worm-bored stone from the shore, or masses of freestone, answer well. On the latter the spores of the green Algæ take root readily. Those on which the Actiniæ rest must not be very irregular on their surface. Shells, either recent or in a partially decayed state, may frequently be employed with advantage.

Sometimes this rock-work is built up by uniting different pieces with Portland or other cement. When this is done, the mass must stand for some weeks previous to use in *fresh* water, in order to remove any injurious properties residing in the material used. At Newcastle, masses of irregular brick-work have been made for attaching to the sides of the Aquarium, and thus imitating the sides of rock-pools.

The arrangement of these into arches, grottoes, and other devices, will call forth the ingenuity and taste of lady collectors, as much of the beauty of the Aquarium depends on the way these are planned. A happy medium must be struck between too many

and too few rocks and stones. In the former case there is not room for a sufficiency of water, and in the latter there may be a deficiency of shade and scope for display of the green or red fronds of the Algæ.

Water.—At this stage the Aquarium is supposed to be ready for filling with water, and prepared for the reception of its inhabitants. Those who reside at or near the coast will have no difficulty in procuring the necessary supply. Where at all practicable, it is desirable to have it from mid-channel, as being that most free from impurities; that, however, from the shore, especially at full tide, will do very well, so that it is not taken too near the inlet of a fresh water stream, or in places where noxious gaseous, or liquid matters may be flowing outwards from the land. The casks or jars which are used for bringing it home, as well as their stoppers, must be scrupulously clean, and free from the taint of any liquid that they may have contained previously, as a little neglect in this particular has frequently proved fatal to large numbers of the marine animals. The tannin principle, in new oak-wood casks, is prejudicial. Nice plans of baskets, fitted up for the use of collectors, with glass jars, bottles, and implements for chipping off the rocks, with weeds and sea-anemones,

are described by Mr. Gosse and other writers. These vessels should stand for a day or two before the water is drawn off into the Aquarium, that any sediment may fall to the bottom. To prevent any shaking when this is done, a siphon of zinc or gutta-percha should be used, allowing the water to fall on a smooth surface, such as the bottom of a saucer, that the gravel or sand be not disturbed. Such as live at a distance from the sea, and have a large Aquarium to supply, instead of getting the necessary quantity of water sent them, may, with the aid of the chemist, provide themselves with an artificial preparation, in which marine animals and plants will thrive almost as well as in their native element. The following component salts, when mixed with rather less than four quarts of spring water, were found by Mr. Gosse (see Magazine of Natural History for July 1854) to answer the purpose admirably :—

Common table salt 3½ ounces.
Epsom do. ¼ „
Chloride of magnesium, 200 grains Troy.
Chloride of potassium, 40 „

Those who do not wish to have the trouble of obtaining and weighing separately the different ingredients, may have them done up in one packet. Enough for three gallons may be had for a shilling.

These salts must first be well mixed in the water, and afterwards passed through a filter into the tank or vessel which is to constitute the Aquarium, and whose floor is provided with the proper stones or sand. A bee-glass or flower-pot, with a piece of sponge tightly fitted into the orifice, with a handful of powdered charcoal above, makes an excellent filter, and, as we shall see further on, may be called into requisition on other occasions. A few healthy plants of Greenweed (Ulva, etc.), should now be introduced, and, after standing for about ten days, it may be considered ready for receiving some of its hardier inhabitants. The mixture of a very little real sea-water with this artificial preparation will considerably hasten the ripening of the latter.

Evaporation of the Water.—This will take place of course more or less rapidly in the Aquarium according to the temperature of the surrounding medium. The saline particles of course are not removed, so it is necessary to maintain, by the addition of distilled or spring-water, the original quantity of liquid put into the vessel. The due proportion of this must be estimated either by noting at first the depth of the water, and maintaining it at the proper level, by introducing a little fresh water from time to time, or using the specific gravity bubble 1026 to ascertain the density

of the water. When the water is in proper condition, the bubble should just sink beneath the surface.

Plants for the Aquarium.—Having thus provided our Aquarium, whatever be its form or the material of which it consists, with the necessary bottoming of sand or gravel and proper water, we proceed to stock it with a suitable variety of plants and animals.

Plants are mentioned first, inasmuch as it is on the oxygen given out by them, under the influence of light, that the life and health of the animals in a great measure depend. It is necessary, as has been already noticed, that these Algæ, or marine plants, be immersed in the water for some time previous to stocking it with animals, that a supply of the necessary air be generated, and a growth of animalcules, which constitute a great proportion of the Actiniæ, etc., be promoted. This is more especially requisite when water made artificially is employed. Further reference to this subject will be found under the head of Aeration.

The green Algæ, known to botanists as *Chlorosperms*, are found to be those which give out oxygen in most abundance. They grow in greatest quantity near high-water-mark. Of these the broad-leaved *Ulva* is the most useful. The plants of this found growing in the tide-pools are always more succulent

and healthy than those left dry among the stones and rocks by the receding tide. Next to it may be mentioned *Enteromorpha*, with narrower fronds, and the *Conferva* and *Cladophora* plants, which produce bunches of silken or woollen fibres floating in the sea-side pools. These, therefore, especially the Ulva, it is better to have first and by themselves in the Aquarium. A few small pieces are quite sufficient for several gallons of water.

Next to these in point of usefulness are the red-spored Algæ (*Rhodosperms*), those beautifully cut and feathered species so well known in a dried state. Of this large family, *Laurencia pinnatifida*, *Iridæa edulis*, *Phyllophora rubens*, *Corallina*, some *Delesseriæ*, *Chondrus*, purple specimens, and *Polysiphoncei*, have been chiefly recommended. They must, however, be introduced at first in small quantity, and with caution, as they may be regarded as the "florists' flowers" of the Aquarium. *Griffithsia setacea* is said to be the "only one" out of many "that may be safely used in a well-seasoned tank of "artificial water." The olive-spored Algæ, *Melanosperms*, represented by tangles, oar-weed, etc., are, with few exceptions,* unsuited for the Aquarium.

* Small healthy plants of *Fucus serratus* seem one of these. Small pieces of those on whose fronds the interesting *Polyzoa* abound may also be introduced to the Aquarium.

They give off a mucous substance in great quantity, which cannot be got rid of as in the wide ocean, and speedily injures the purity of the water.

In procuring these plants, it is desirable to have them in a fresh and growing state, so that, if chipped off with a portion of the rock or stone on which they are found growing, success with them is more certain. The Ulva, however, is not quite so nice, and it is a frequent thing to find it in an Aquarium floated with a piece of cork. Any decaying portion, which in the green species appears in white, and in the red in orange patches, should be carefully removed as soon as it becomes visible, and if this is attended to the rooting of the plant is a matter of little importance.

Before putting in the weeds, care should be taken to remove from them, or the pieces of rock to which they may be attached, any small shell-fish, sponges, or zoophytes which may be adhering to them, otherwise they will speedily die and corrupt the water. It is amazing how much damage may arise from a very little neglect in this particular. The red species are more apt to be infested with the sponges and zoophytes, and some of these can scarcely be detected till they are put in water, when the parasites are detected by the rough or hairy substance clothing their stems and fronds.

Besides promoting the health and affording protection to the animals in the Aquarium, these Algæ, when judiciously arranged on its floor or rockwork, add much to its beauty, and afford scope, as has been already hinted, for exercising the taste of the Aquarian.

Animals.—We will now suppose that the water is in good condition, from having, for the necessary time, been provided with the requisite plants, and that it is thus ready to receive its animal inhabitants. The first and most important advice we would give is to proceed cautiously, and not overcrowd. One is very apt, on starting, to get a host of shell and star-fish, Actinias, and other zoophytes, and plunge them by the dozen into a vessel fitted to maintain, in proper state of health, scarcely half-a-dozen creatures of ordinary size. It is no wonder, when we consider the conditions necessary to their existence, that after a few hours the greater number are dead. The cause of this will be better seen when we come to speak of Aeration.

In case of injury in removing them from their rocks or pools, or exhaustion from distant carriage, it is desirable to keep the more valuable or delicate animals separate for a time. This may easily be done by having a supply of jelly-pots, or glasses of

similar size, at hand. Even when removed most carefully, some species of Actinia give out for some time after a mucous secretion, which has the effect of dimming the transparency of the water, rendering the Aquarium less an object of interest than it would otherwise be.

The greater proportion of animals suited for the Aquarium are those found between high and low-water-mark, and among these we find a beauty and variety well calculated to excite interest. Along with them grow the green and red Algæ, on which they are dependent for food and shelter. Those animals whose home is the deep sea can only be obtained by dredging, and many of these are but short-lived, as the conditions of the ordinary Aquarium do not admit of all the benefits they are accustomed to in their native recesses.

It will not be expected that in the space devoted to these few remarks we should give the names of the different genera or species suited for the Aquarium, or minute details regarding the specific treatment required by each. More elaborate works must be consulted on that subject, and all we will attempt at present is to name a few of the leading families united in ordinary collections. The genus Actinia, or Sea Anemone, stands first on the list as being at

once a most beautiful and conspicuous object of marine life. There are several species, varying considerably in size and colouring, but in outline they have many points of resemblance. From the base adhering to the rock rises a rounded or cylindrical body, marked in various ways, and from the top of the body spread out all round rows of tentacles, resembling little horns, which aid the animal in seeking its food. The three species best known to collectors are *A. Mesembryanthemum*, *Dianthus*, and *troglodytes*, being more or less common on all our British shores. The first is the well-known red or purple species, sometimes olive brown, always found near high-water mark. It is a very hardy animal, and, with its red tentacles and blue eyes, is a very pretty object. A variety of it (*A. fragacea*), spotted like the fruit of the strawberry, is found on the coasts in the south of England. *A. Dianthus*, known better to many as the Feathered or Plumose, is found on the rocks or stones only at extreme low-water mark. It varies much in colour, being pure white, bright orange, or tawny buff. The lobed divisions of its upper portions, furnished with numerous and delicate tenticles, are beautifully transparent objects, and closely resemble plumes of feathers. The third we have mentioned has been named the

"Cave-dweller," from preferring as its home the under side of stones and rocks, or burrowing in the sand. It boasts no bright colour, as that is usually of a dingy brown. A large and common species, the *Actinia crassicornis*, though generally brought in and much admired, does not thrive well in confinement. Other beautiful species, *A bellis*, *clavata*, *gemmacea*, etc., confined to particular districts, need not be noticed here. As all adhere, when in a state of health, to rocks and stones, they should be dropped gently on these when placed in the Aquarium. The star fishes and urchins are also beautiful animals. The former require constant feeding to keep alive, and neither are well adapted for the purpose. Sea-slugs (*Eolis*, *Doris*, etc.) are interesting and richly-coloured, but some of them are apt to prey on the Actiniæ, and few can be kept for any length of time without frequent changes of water. Barnacles, Serpulas, and other small animals, afford objects of much interest. All the above are quiet living animals, so that it requires the addition of some crabs, especially the "hermit," prawns, shrimps, or small fish, to enliven the miniature grottoes of the Aquarium. These also, of one kind or another, are widely distributed, so can be had in such places as the others are gathered. Some of the shore univalve

mollusks, or shell-fish, among which are pre-eminent periwinkles or whelks (*Littorina*), and tops (*Trochus*), are both interesting and useful tenants, as they assist in removing the superfluous vegetable matter that collects in the Aquarium. These, and some other marine animals, love at times to get out of the water to breathe the air more freely; for such, a rock projecting above the water may be used either permanently or temporarily.

All these, however, as has been already hinted, do not constitute a united happy family; so that if considerable variety is kept, it will be well to keep the carnivorous species apart.

A rapid glance has thus been taken at the plants and animals suited for the Aquarium, and the state they should be in when committed to it.

We will now consider briefly the several conditions necessary to *maintain* them in a state of health and vigour. These are appropriately arranged under the three heads of light, heat, and air, according as they are affected by these agents.

Light, it is well known, is an important agent in sustaining all animal and vegetable life. Its effects, however, do not seem to be quite similar when carried through the medium of air and water, or there are some counteracting influences in the latter which

produce different results. Land plants get blanched and sickly while deprived of it for any length of time, whereas marine vegetation appears in bright colours when shaded in crevices by overhanging rocks, or at considerable depths in the ocean. Deep-sea animals have also brilliant colours.

In speaking of plants suitable for the Aquarium, we found that the green Ulva and others of similar structure were the best. These, growing nearest high-water mark, are much exposed to the influence of light; and as it is desirable that the Aquarium be placed in a situation in which its contents may be sufficiently seen, as well as kept in a state of health, these ends are promoted by the growth of the Ulva in such situation. Many of the shore animals, such as hermit crabs, prawns, star-fish, etc., lose a portion of their bright colours when transferred to the Aquarium, which leads us to suppose that these fade from the animals being exposed to a greater degree of light than in their native haunts. The different food they are necessarily restricted to may have some effect.

From all this it will be seen that great degrees of light are not favourable, much less necessary, for the health of the inmates of the Aquarium. The direct rays of the sun need not reach them at any time,

and should never do so in warm weather. To soften the influence of the light, glass covers and sides of a deeper shade of glass, or green muslin shades, are used with advantage. These may be permanent or temporary in use.

Temperature.—Heat is an agent equally necessary, if not more so than light, to be consulted in the management of the Aquarium. While marine animals, especially those that frequent the shore, are exposed to considerable extremes of heat and cold, there is a medium temperature peculiarly adapted to their constitution. It is well known that the range of temperature varies less by some degrees in water than in the atmosphere. In our latitudes, it has been calculated that the temperature of the ocean varies from 68° to 41°. This we must endeavour to imitate by not keeping the Aquarium in too warm a room during winter, and avoiding its exposure to the rays of the mid-day sun in summer. Many have lost their collection from neglect in this particular. A thermometer fitted for using under water is therefore useful to those who are extensive Aquarians.

Aeration.—In the earlier portion of these remarks attention has been directed to the beneficial influence mutually, by the plants and animals on each other, from the gases given out by them respectively, as in

the productions of the land. On the principles thus established, the healthy state of both is promoted by the disturbance of the water in various ways effecting a thorough aeration of the whole. By the appliances referred to, the action of the waves and spray to which they are accustomed in their native element is closely imitated.

There are various modes in which this important service may be rendered to the contents of the Aquarium. The first and simplest is that of breaking the water near the surface with a flattened piece of wood or similar implement, by which the action of the waves is imitated, and in course of time the whole water exposed to the action of the atmosphere. Next to that is the syringe; one of glass is the most useful, and the size recommended by Mr. Gosse is that of which the cylinder measures $1\frac{1}{2}$ inches in diameter. When in use the down stroke should be given at a considerable height above the water, so as to carry as much air as possible along with it. The beneficial effects of this process will often be visible by its refreshing effects on the Actiniæ and other animals. The drip-glass is another simple and efficient plan for aerating the water of the Aquarium. It consists of a bell or bee-glass, with an aperture at the lower end, into which a piece of sponge is firmly fixed. This is filled with water, suspended at a

considerable height above the Aquarium, and allowed to drip slowly on the surface of the water below. A constant and fresh supply of air and water is thus furnished, and the process may be suspended or renewed as is found suitable.

The Aquarium, with fountain attached, is still another contrivance for supplying fresh water and air, but, as may be expected, the apparatus required for working it properly is necessarily of a more complex nature. A body of water must be provided at some considerable height above the tank, which, whatever its form, should stand on a pedestal. Between this *upper* tank and the Aquarium there must be a communication by a tube passing up through the foot of the pedestal and above the surface of the Aquarium. The end of this tube should be provided with a glass-nozzle to prevent corrosion. By this means an elegant *jet d'eau* may be obtained in a lobby, greenhouse, etc., at the same time that the water and animals are kept in fresh and vigorous state. A representation of this Aquarium will be found in the frontispiece to Mr. Gosse's "Handbook to the Aquarium."*

Such are some of the modes of keeping the Aquarium and its contents in a healthy condition. Not-

* There are several modifications of this mode of aeration on the siphon principle, by which air or water are conveyed to the Aquarium, regarding which details cannot here be given.

withstanding all the care and precaution that may be given, the hopes of the Aquarian will at times be disappointed, and this may occur after all seems well established. It is to meet such cases that a few other matters connected with the management of the Aquarium are touched upon in conclusion.

Covering of the Aquarium.—As it is usually intended for an ornament to the parlour and drawing-room, rather than for scientific purposes, the Aquarium will unavoidably be exposed to layers of the dust and other extraneous matters which fly about the most tidily-kept room. Though no material injury arise to any of the inmates from this cause, its effects will be seen by the brown sediment which accumulates at the bottom of glass vases and vessels of a similar construction. Where tanks with gravel bottoms are used, it is not so soon detected. To prevent this drawback various covers are employed. Sheets of deep green glass, which admit of being raised up at intervals for the admission of air, answer well. Green muslin caps fitting tightly also look neat. Some approve of finely perforated zinc covers, which suit very well in some Aquariums. These last will not prevent access of the finer dust.

Removing dead Animal and Vegetable Matter.—Let the plants and animals be as free as could be desired from injurious substances that may adhere to

them, in time decay and death will come to them, or portions of their substance. These must be removed as soon as their presence is detected, otherwise the water will speedily get clouded and polluted; and should it proceed further, blackened shells and most offensive odour will reveal the cause. Some animals, however, take shelter at times under stones or in the grottoes of the Aquarium, so that their occasional absence from view need not occasion too much alarm. The whelk or periwinkle, and one or two allied shell-fish of the same description, eat up much of the decaying vegetable matter that would otherwise accumulate in the Aquarium; but the only mode of getting rid of the bad effects produced by the dead or sickly animals is their removal in time. These latter may be kept apart in separate vessels to see if they can be recovered by the application of fresh sea-water and aeration. During summer the spores of Ulva and other green Algæ begin to grow and cover the sides of the Aquarium, sometimes to such an extent as to prevent its contents being well seen. Of this the mollusks we have just named are very fond, and the process of their feeding on it is an interesting object for observation. Destitute of such a substitute, a soft piece of rag attached to a piece of wood will effectually remove this.

Turbidity and Discoloration of Water.—One great

beauty of the Aquarium is the perfect transparency of the water contained in it. With the utmost care, however, this cannot always be obtained. If the plants and animals are not well cleaned and carefully looked to at first, they are very apt to make the water cloudy, and unfit for keeping its inhabitants in a healthy state. When the water is taken from near shore during stormy weather, it is some time ere the sediment it contains settles down. In addition to these causes, however, which can be well accounted for, there are others which frequently produce similar results.

Frequently, after the Aquarium has been thoroughly established, a light grey or whitish dimness, often in patches, discolours the mass of water. This is probably caused by the death of one or more minute animals, whose solid and liquid parts constitute the food of myriads of animalcules, the individual forms of which can with difficulty be observed with the highest power of the microscope. When the dead matter has been removed, these animalcules also vanish; but it is well, when this symptom of disorder is observed, to remove the larger animals to a temporary place of safety.

The opacity of the water, however, may arise from another cause. When it is of a green shade of colour, it arises from spores of Ulva and other green

Algæ floating in the water. Though not injurious, as in the former case, to the animals, it is very unsightly, and does not disappear so readily. The only remedy for this seems to be that suggested and adopted by Mr. Gosse—the removal of the Aquarium for a time to a place of complete darkness. By this means the spores die away from being deprived of the stimulus of light, and the water resumes its wonted clearness. In the interval, the animals, as in the former case, should be kept in another vessel.

Feeding of Animals.—More diversity of opinion appears to prevail on this subject than on most others connected with the management of the Aquarium. The Actiniæ, or Sea Anemones, seem not to be very nice in their food, swallowing whatever animal food they can lay their tentacles on and around, from large shell-fish down to minute animalcules. Mr. Gosse thinks the latter in a well-established Aquarium should afford sufficient nourishment for all the Actiniæ suitable for a given space of water; others say they feed their pets constantly, and find their health and vigour evidently promoted by it. Perhaps a medium between these two plans will be found effectual. The former seems the safer course, but experience must ever be the best guide in individual cases. The *radiata* (urchins and star-fish) require more feeding than the others, and the crabs also,

were it only for the amusement of seeing them at dinner time, may get occasionally a little animal food. Where shell-fish, or such other food as may be supposed natural to them, is not to be readily had, small pieces of the lean of raw meat may be given. After what has been said regarding the removal of dead matter, it is scarcely necessary to urge further here the importance of removing whatever food of this sort they may leave.

The vegetable feeders find sufficient nourishment in the weed, which is constantly growing, and *their* numbers should also be proportioned to the supply of this description of food.

Implements.—Dealing, as the Aquarian has to do, with such a variety of material as is comprised between hard rocks and the soft and almost transparent bodies of some marine animals, a considerable variety of these will be required in the various operations, though none of them need be of a very expensive nature. In collecting, a hammer, chisel, and strong knife, either clasp or sheath, will be indispensable for removing the animals or weeds, besides jars of earthenware, or glass, or cans, as may suit the convenience of the collector for bringing the captives home in. It is scarcely necessary to add, that in doing so care should be taken to arrange what is gathered in such a manner, that the more delicate

animals and plants be not injured by the stones and shells which are gathered along with them. For home work, when the Aquarium is fairly set a-going, we may mention the following as more or less necessary.

Two or three spoons of wood or metal, that will not corrode, but ivory or bone may answer better. Where expensive material is used, the bowl alone might be made, and the handle made of any neat piece of stick.

Large camel-hair pencils, attached to wooden handles, for removing any injurious substances from the animals or weeds.

Glass-tube, one or two pieces of different diameter and length, to remove, on the siphon principle, decaying substances from the bottom of the Aquarium.

Metal or wooden forceps, for larger objects of this sort. A piece of good whalebone bent together, and tapered at the points, makes a very useful implement for removing injurious substances.

Small landing nets, of larger and smaller meshes, attached to handles, for the removal of substances floating on the surface, or throughout the water.

For those who have time and wish to add to their amusement, a regulating thermometer, lenses on stand for viewing the objects, and sundry other apparatus, might be added.

R. M. STARK

Having fitted up a portion of his New Premises at 31 SOUTH CASTLE STREET for **Marine Aquaria,** will be happy to be favoured with a visit and inspection of those interested in the pursuit of this and kindred branches of Natural Science.

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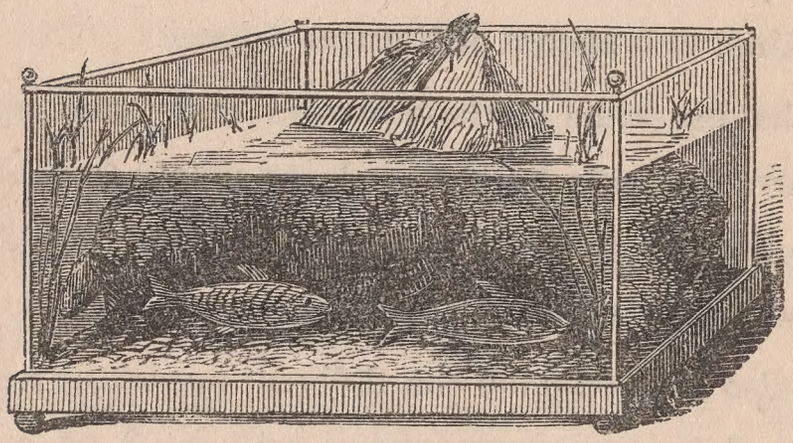

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